DOCUMENT RESUME

ED 372 112 TM 021 937

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TITLE Portfolio Assessment in Vermont, 1992-93: The Teachers' Perspective on Implementation and Impact.
SPONS AGENCY Office of Educational Research and Improvement (ED), Washington, DC.
PUB DATE Apr 94
CONTRACT R117G10037
NOTE 32p.; Paper presented at the Annual Meeting of the National Council on Measurement in Education (New Orleans, LA, April 5-7, 1994).
PUB TYPE Reports - Evaluative/Feasibility (142) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Educational Assessment; Grade 4; Grade 8; Inservice Teacher Education; Intermediate Grades; Junior High Schools; *Mathematics Tests; *Portfolios (Background Materials); Program Implementation; Scoring; *State Programs; Teacher Attitudes; Testing Programs; Test Results; Test Use; Test Validity; Writing Evaluation; *Writing Tests
IDENTIFIERS *Performance Based Evaluation; *Vermont

ABSTRACT

In 1991-92 Vermont initiated a statewide portfolio assessment program in mathematics and writing in grades 4 and 8. An evaluation of the program found mixed results--although the portfolio scores were unreliable for individual or school-level reporting and teachers had concerns about implementation, the assessment had marked positive effects on instruction. This paper describes the implementation and impact of the second year of the assessment in 1992-93. Issues addressed include time spent on mathematics portfolios and best pieces, inservice training and support, changes in curriculum and instruction, portfolio preparation and scoring practices, and teacher and student attitudes toward the portfolios and student performance. Overall, the message from the more than 600 Vermont teachers surveyed about the portfolio assessment system remains mixed. Many feel that modifications they have made to emphasize problem-solving and mathematical communication skills have come at the expense of other areas of the curriculum, especially basic skills and computation. There is also little evidence that teachers' burdens in planning, administering, and scoring portfolios are decreasing. Fourteen tables present findings from teacher surveys. (Author/SLD)

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# PORTFOLIO ASSESSMENT IN VERMONT, 1992-93: THE TEACHERS' PERSPECTIVE ON IMPLEMENTATION AND IMPACT

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RAND

Paper presented at the annual meeting of the National Council on Measurement in Education, April, 1994, New Orleans, Louisiana.

The research on which this paper is based was funded by cooperative agreement number R117G10037 and CFDA catalog number 84.117G as administered by the Office of Educational Research and Improvement, U.S. Department of Education. The views expressed here do not reflect the position or policies of the Office of Educational Research and Improvement, U.S. Department of Education.

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**ABSTRACT**

In 1991-92 Vermont initiated a statewide portfolio assessment program in mathematics and writing in grades 4 and 8. An evaluation of the program found mixed results -- although the portfolio scores were unreliable for individual or school-level reporting and teachers had concerns about implementation, the assessment had marked positive effects on instruction. This paper describes the implementation and impact of the second year of the assessment in 1992-93. Issues addressed include time spent on mathematics portfolios and best pieces, inservice training and support, changes in curriculum and instruction, portfolio preparation and scoring practices, teacher and student attitudes toward the portfolios and student performance.

## INTRODUCTION

For the past five years Vermont has been developing an innovative statewide assessment system in which portfolios of students' work in mathematics and writing are a key element. The Vermont program has two primary goals -- to provide a valid measure of student performance and to encourage changes in curriculum and instruction that promote higher-order thinking. Vermont is the first state to make portfolios the centerpiece of a statewide assessment system, and the state's pioneering efforts have attracted nationwide attention. The Vermont experience provides a valuable source of information about the challenges and consequences of using portfolios in large scale assessment and using assessment to drive curriculum reform.

Since 1990, the year portfolios were first piloted, RAND has been evaluating the program under the auspices of the Center for Research on Evaluation, Standards, and Student Testing (CRESST). This paper describes the implementation and impact of mathematics portfolios in the second year of statewide implementation, 1992-93. This evaluation focuses primarily on the mathematics portfolio assessment because the use of portfolios in this subject represents a clearer break from extant practice and is, from a national perspective, more unusual.

Many of the issues raised in RAND's evaluation of the pilot year and first year of statewide implementation (Koretz et al., 1993) are revisited here. Last year's teacher survey revealed significant changes in curriculum and instructional practices consistent with the goals of the portfolio assessment, but also indicated that portfolios placed a substantial burden on teachers' time. Moreover, there were significant variations in teachers' approaches to portfolios, which would affect the interpretation of portfolio scores. This year's results are similarly mixed. While desired changes in curriculum and instructional focus were sustained in the second year, there was no substantial reduction in the

time burden portfolios placed on teachers. About one-half of the teachers see a payoff for their extra effort in terms of improved student learning; one-half do not. Substantial variations in teachers' approaches to portfolios also persist. Finally, although most teachers express continued support for math portfolios, they have strong reservations about some of the state's goals for the program, particularly the emphasis on using portfolio results for formal external assessment purposes.

**PROCEDURES**

This study is based on data from questionnaires that were distributed to all teachers of mathematics in grades 4 and 8 in the spring of 1993 along with the state's Uniform Test.[1] Teachers were asked to complete the questionnaires anonymously and to return them with the completed student test booklets. Most survey questions were Likert-type items, requiring respondents to select one of five or six ordered responses. A few items required teachers to estimate the percentage of time devoted to particular activities or the percentage of students behaving in certain ways. There were two open-ended items requiring written responses.

Five hundred nineteen completed questionnaires were returned, three-fourths from grade 4 and one-fourth from grade 8. This represents approximately 52 percent of all Vermont teachers who taught mathematics in grade 4 and 41 percent of mathematics teachers in grade 8.[2] Although this response rate is much lower than last year's (83%), the total number of respondents is more than three times as large, including one-half of the entire population. Responses to all survey items were keypunched and analyzed by computer. A random sample of 50 percent of

[1] This is the third year in which teacher questionnaires have been administered as part of the RAND evaluation; however, previous questionnaires were sent only to a sample of teachers.

[2] These are the most conservative estimates of the response rate. They are based on the total number of teachers who teach mathematics at each grade level in the state. However, because of variations in distribution and testing procedures at the local level, we do not know that all eligible teachers received the survey.

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the papers with written responses to open-ended items was selected, and these responses were read, summarized, and tabulated by hand.

**RESULTS**

This section begins with a description of the characteristics of teachers who completed the survey, then proceeds with a thematically organized discussion of the research findings. This discussion focuses on questions related to: *implementation* (specifically, inservice training and portfolio practices at the classroom level); *impact* (changes in curriculum and instruction, student performance, and teacher attitudes); and the *burdens* portfolios place on teachers and students.

**Teacher Characteristics**

The characteristics of teachers who responded to the survey are almost identical to those of the 1991-92 random sample, giving us more confidence in the generalizability of the survey results. The typical Vermont mathematics teacher has considerable classroom experience. (see Table 1) On average, eighth grade teachers have 16 years of experience and fourth grade teachers a little less than 15 years. Less than 10 percent of the respondents have under four years of experience. Consistent with traditional elementary and middle school scheduling practices, 70 percent of eighth grade teachers specialize in teaching mathematics (as opposed to teaching many subjects) while less than two percent of fourth grade teachers specialize in mathematics.

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Insert Table 1 about here

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A large majority (82%) of respondents have at least one year's previous experience with the mathematics portfolios. For the most part, those teachers (18%) who had not used math portfolios before the 1992-93 school year simply did not teach mathematics at grade 4 or 8 in 1991-92. Over 20 percent of the teachers had two years experience with the math portfolio: one-fifth of the fourth grade teachers and one-third of the eighth grade teachers participated in the 1990-91 pilot program.



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**Training and Support**

Vermont has provided portfolio-related training activities each year to meet the needs they perceived to be the greatest. For example, during the first year of implementation the focus of training was on explaining portfolio procedures and finding appropriate tasks. In 1992-93, the training focused on the scoring criteria. The level of satisfaction with training in 1992-93 was comparable to 1991-92. Over one-half of the teachers at both grade levels feel adequately prepared to work with the mathematics portfolios as a result of the training they received. Shortcomings in training were reported more often at grade 4 than grade 8. One-quarter of the fourth grade teachers, compared to only 12 percent of the eighth grade teachers, feel poorly or very poorly prepared to work with the portfolios. Fourth grade teachers also rate the network scoring training sessions somewhat lower than eighth grade teachers. Approximately one-half of eighth grade teachers rate the two network scoring training sessions as good or very good, compared to about 40 percent of the fourth grade teachers.

Less than 10 percent of teachers wrote open-ended comments specifically about training. Most of these teachers say that training sessions placed too much emphasis on scoring portfolios and not enough attention was given to how to teach portfolios effectively. A few teachers complain of having to be away from their students too often to attend training sessions.

**Variations in Classroom Implementation of Portfolios**

One concern raised loudly in last year's RAND evaluation and echoed in teacher's open-ended comments this year was that portfolios are not implemented uniformly across classrooms and schools. Several items on the questionnaire reveal extensive variation in portfolio-related policies and practices. For the most part, this variation has not lessened since 1991-92. The percentage of teachers reporting that students' generally revise their best pieces at least once has risen from 73 to 80 percent. The mean number of revisions at grade 4 is virtually unchanged from last year (1.17), but there is a modest increase from 1.00 to 1.10 at grade eight. Nevertheless, teachers'



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policies on revising best pieces still vary significantly. Although 57 percent of teachers encourage revision of most best pieces and 19 percent permit revision, another 19 percent *require* at least some revision, and 5 percent generally *do not permit* revisions. Similarly, the amount of time students spend revising varies widely. The average revising time is 30-40 minutes, but in roughly 17 percent of classrooms students do not revise at all. In another 15 percent of classrooms students take more than one full class period to revise a best piece. Students who are not encouraged or allowed to revise their best pieces will clearly be at a disadvantage relative to those who are encouraged, or even required to revise their work.

Teachers also set policies regarding who may assist students in revising their best pieces. One in four teachers do not assist their own students in revisions, and a similar proportion do not permit students to help each other. Seventy percent of fourth grade teachers and 39 percent of eighth grade teachers forbid parental or other outside assistance. (see Table 2) The remaining teachers permit their students to receive outside assistance. This is consistent with 1991-92 results which indicated that 65 percent of teachers at grade 4 and 43 percent at grade 8 placed some limit on parental assistance with portfolio projects. Further complicating matters, roughly 10 percent of teachers have different rules for each student. Teachers' policies also differ with respect to acknowledgment of outside help. Only about 20 percent require students to acknowledge or describe the assistance they receive.

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Insert Table 2 about here

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The type and quality of the work that becomes part of a students' portfolio is also heavily influenced by teachers' decisions about how best pieces are selected. Fourth grade teachers generally provide students with more guidance in selecting best pieces than do eighth grade teachers. However, this year's survey, like last year's, reveals substantial differences in the amount of teacher influence within grade levels, with some teachers playing an equal role with the student and others playing no role at all. (see Table 3)



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Insert Table 3 about here

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On the other hand, there are many similarities in portfolio practices. Most teachers are using mathematics portfolios with nearly all of their students: ninety-six percent reported that most, almost all or all of their students are compiling mathematics portfolios. Those who are excluded are primarily students from other grade levels who are enrolled in multi-grade classes. About 15 percent of teachers also excuse some special education students from participation in the portfolio assessment.

Another area of congruity is in teacher's decisions about how much emphasis to place on different characteristics of best pieces. These decisons can have a subtle, but systematic, influence on the types of work students include in their portfolios. The vast majority of teachers place a moderate or heavy emphasis on the assessment scoring criteria, and also on work that is "interesting or important to students." Most teachers place minor or moderate emphasis on students pieces being mathematically correct and having a neat and polished appearance. (see Table 4) Other than a small decrease in emphasis on student work being similar to examples in the Resource Guide, there has been very little change in emphasis since last year. It may be that training and scoring experience have helped to bring about this consistency of approach.

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Insert Table 4 about here

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**Changes in Curriculum and Instruction**

One of the major goals of the mathematics portfolio program is to improve curriculum and instruction at the classroom level. In an attempt to measure these changes, we asked teachers to compare their current teaching activities with their approach before they started

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using portfolios.[3] As in 1991-92, most teachers report substantial changes in curriculum focus and teaching methods since they began using portfolios, changes that are consistent with the goals of the assessment program. These changes are more pronounced in the fourth grade than the eighth grade, which may be attributed to greater flexibility in scheduling and curriculum.

Curriculum changes are greatest in the areas of problem solving and mathematical communication, which are emphasized by the Vermont mathematics portfolio assessment. Most teachers are spending more classroom time in these areas in 1992-93 than they did prior to using portfolios. In the fourth grade 83 percent of teachers devote more class time to "learning problem solving techniques" than they did before the introduction of mathematics portfolios. (see Table 5) Over 70 percent of fourth grade teachers say they spend more class time applying math to novel and real world problems and solving logic or reasoning problems. Of the eight specific problem solving activities mentioned in the survey, only traditional word problems are receiving the *same or less* class time in more than one-half of fourth grade classes.

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Insert Table 5 about here

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Curricular and instructional changes are not as great in the eighth grade. Fewer eighth grade teachers report increases in class time devoted to problem solving than fourth grade teachers. Less than one-half of the eighth grade teachers spend more class time on four of the eight listed problem solving activities. Nevertheless, two-thirds do give more attention to learning problem solving techniques.

The changes are similar for mathematical communication. Eighty-nine percent of fourth grade teachers and 77 percent of eighth grade teachers are placing more emphasis on writing about math. (see Table 6) Over 70 percent of fourth grade teachers say they are devoting more time

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[3] The vast majority of teachers started using portfolios in 1991-92. However, approximately 20 percent of the teachers participated in the portfolio pilot the previous year. These teacher were comparing the present year to the year prior to 1990-91.

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to explaining solutions to problems and discussing mathematics. But a substantially smaller percentage of eighth grade teachers report such increases. A majority of eighth grade teachers spend the same or less time in four of the five areas of mathematical communication listed on the survey.

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Insert Table 6 about here

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There also have been changes in the types of instructional activities, although this has occurred less widely than changes in curricular focus. Just over two-thirds of teachers said that the portfolio assessment has moderately or greatly encouraged them to be innovative in planning mathematics lessons and activities. A slight majority of fourth grade teachers engage in more open-ended activities and activities involving novel materials or supplies; but less than one-half of eighth grade teachers do so. (see Table 7)

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Insert Table 7 about here

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The portfolio assessment also has affected the organization of mathematics instruction. About one-half of fourth grade teachers and one-third of the eighth grade teachers have changed the way they group students during class in ways consistent with portfolio program objectives. There has been a modest shift away from individual work and toward whole class discussion, mixed ability groups, and working in pairs. However, for each type of class grouping a substantial proportion of the teachers at both grades reported no change. (see Table 8)

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Insert Table 8 about here

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Increased attention to the topics and activities encouraged by the math portfolio program has come at a cost to other areas of the mathematics curriculum and, at grade four, to other subjects. Two-thirds of teachers are choosing to spend less time on computational



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skills and "other traditional math topics," and the majority of teachers agreed with the statement that "the portfolio assessment makes it more difficult to cover the mathematics curriculum." (see Table 9) In the fourth grade, 44 percent of teachers are spending less time on subjects other than math and writing.

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Insert Table 9 about here

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We asked teachers to rate the frequency with which various classroom activities occurred. Problem solving activities of one sort or another occur, on average, once per week. (see Table 10) Although problem solving occurs less frequently than computation (which takes place two to three times per week), teachers indicate they are doing considerably more problem solving now than prior to the introduction of the portfolios. More unusual and challenging problem solving activities occur less often.

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Insert Table 10 about here

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Teachers expressed concern that "basic skills" are getting lost in the portfolio effort. In their written comments they frequently noted that portfolio activities take time away from basic skills and computation, which still need attention. One of the most common open-ended comments was about the difficulty of finding time for the normal math curriculum and portfolios. As one teacher stated, "Until the curriculum outlines change to allow more portfolio-like tasks teachers will be doing a balancing act between covering the curriculum and embracing portfolio tasks." For many teachers math portfolios are another add-on to an already busy curriculum, forcing them to make difficult choices.

**Student Performance**

Teachers are evenly split in their opinions about whether the program is promoting greater learning of mathematics. Fifty-one percent report that students are learning mathematics better because of the

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portfolios, while 40 percent believe student learning is "Neither better nor worse." Only 9 percent feel that portfolios have actually been detrimental to students.[4] We asked teachers to explain their responses to this item and 77 percent did so, often in considerable detail. Positive statements about student learning (made in 69 percent of the comments) focus mainly on improvements in students' thinking and reasoning about math. Also common are comments that portfolios encourage students to explain their ideas and relate math to real life, which improves their understanding of mathematical concepts.

Over one-half of the teachers made negative comments about the impact of portfolios on student learning, often mentioning that learning is worse (or not any better) because other areas of the math curriculum have to be cut to make time for portfolios. The most frequent negative teacher remark (made by 15% of the teachers who commented on this item) is a reference to cutting back on basic skills or computation. Many feel the need for better balance between these activities and portfolios. Another frequent concern is that younger students are being turned-off to math because of the writing demands of portfolio tasks. Several fourth grade teachers (11% of the student learning comments) mentioned that the writing required for math portfolio tasks is developmentally inappropriate, particularly writing that relates to the PS4 criterion.[5] Teachers also repeatedly expressed the need for portfolios to be implemented at all grade levels for there to be a significant impact on student learning. Three-quarters of teachers at grade 4 and two-thirds at grade 8 agree with the statement that "Math portfolios should be expanded to all students in all grades."

Differences between students' performance on traditional mathematics assignments and portfolio tasks was less this year than in 1991-92. On average teachers said one-half of their students performed

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[4] These results are based on teachers' professional judgment about student learning and student ability levels. They should be interpreted cautiously since student learning may be difficult to characterize across ability levels, especially in the midst of a substantial shift in curriculum focus and instructional practice.

[5] PS4: What decisions, finding, conclusions, observations, connections and generalizations the student reached?

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about the same on the two types of tasks, compared to about one-third of the students in the previous evaluation. Nevertheless, about one-third of fourth grade students and one-quarter of eighth grade students did worse on portfolio tasks than on traditional math assignments, while the remainder did better.

There does appear to be a correlation between students' ability levels and how well they respond to portfolio work. Teachers generally think that high ability students have a more positive reaction to portfolios than do low and average ability students. For example, high ability students are more likely to "enjoy portfolio work more than regular math assignments," and are less likely to be hampered on math portfolio tasks because of poor writing skills. (see Table 11) Teachers indicate that a smaller proportion of their low ability students are "learning more math because of portfolios." And while most teachers report that few or none of their students find portfolio problems easier than traditional assignments, they find this to be true least often with low ability students.

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Insert Table 11 about here

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**Teacher Attitudes Toward the Portfolios**

Teachers have mixed views about the mathematics portfolio program. Although there is broad support for portfolios, there is also substantial concern about the implementation of the program and about specific uses of portfolios. Teachers' written comments reflect a mix of enthusiasm and frustration over portfolios. Statements of support for the philosophy behind portfolios are often followed by concerns about state demands.

Teachers think the portfolios are helpful as informal classroom assessment tools, but worry about their use for external assessment purposes. The majority agree or strongly agree that the portfolios help students monitor their own progress, and that portfolios are useful for informing parents about student progress. The majority also agree that portfolio scores should be used as part of students' grades, although



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about one-half of the teachers judge students math work differently when assigning grades than when scoring for the portfolios. Most find the portfolio criteria easy to use, but about one-third report frequent difficulty applying criteria PS3, PS4 and C1. (see Table 12)

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Insert Table 12 about here

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In contrast, teachers are more cautious about the use of portfolios for external assessment purposes. The vast majority of teachers do not believe it would be fair to evaluate them on the basis of students' portfolio scores. While the majority of fourth grade teachers think portfolio scores are a better measure of math learning than standardized tests, eighth grade teachers are about evenly divided between those who agree, those who disagree and those who are uncertain. One of the most common concerns raised by teachers in their open-ended comments was the state's strong emphasis on scoring. Many feel that the emphasis on reliable scoring is misguided and it perverts the original purpose of portfolios as a tool for assessing an individual student's growth. One teacher noted that "The state wants portfolios to be scored like a bubble test for their own purposes...Theoretically, the portfolios were to show personal growth in math and writing abilities."

Teachers are concerned about the validity of portfolios as an assessment instrument. Expressing a common sentiment one teacher asked "How can the validity of scoring outside the classroom be justified when there are so many uncontrolled variables?" About one out of every four (23%) teachers who commented on "other issues" expressed concerns along these lines. Several teachers (5%) also worried that some of their colleagues were providing students with opportunities to improve their work that they felt were inappropriate and were not permitted in their own classes.

There is a strong sense that the changes brought about by portfolios have had a positive impact on mathematics education. Many teachers expressed some support for the portfolio philosophy along with their complaints about the program. For example, fifty-four percent of



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teachers agreed with the statement that "the Vermont mathematics portfolio assessment is moving education in the right direction," while only 21 percent disagreed. Seventy-five percent of the teachers also supported expanding the portfolio assessment to all students in all grades.

**Time Burdens**

As in the past, time burdens are teachers' greatest concern; portfolios consume considerable time both in class and outside of class. However, estimates of the exact amount of time devoted to portfolios are somewhat elusive. Teachers' relative and absolute judgments about the time demands of portfolios are somewhat contradictory. On the one hand, 55 percent of teachers who used portfolios in 1991-92 are spending more out-of-class time this year on portfolios than they did last year, and 60 percent are spending more classroom time than in 1991-92. Fewer than 10 percent report decreases in either figure. On the other hand, estimates of the actual number of hours spent in these two types of activities have gone down by approximately one-third from 1991-92. The difference in these estimates may be explained, in part, by changes in the way the absolute time estimates were gathered between the two years.[6]

Other responses support the conclusion that the portfolios continue to make significant demands on teachers. For example, most teachers at both grade 4 and 8 feel that they spend too much time managing and scoring portfolios. (see Table 13) Most teachers do not feel that the demands of the mathematics portfolio program are lessening, and many are displeased that the burden continues to be so great. Less than one-

[6] In addition to asking teachers to compare this year to last year we also asked them to estimate the actual number of hours they spent on selected portfolio related activities. There were inconsistencies between the results reported in 1991-92 and 1992-93. Although teachers reported spending more time in 1992-93 than previously, their estimates of hours were lower than in 1991-92. Differences in format between the 1992-93 and 1991-92 questionnaires may have contributed to this inconsistency. Since the vast majority of teachers reported spending the same or more time this year than last, we place more confidence in the relative judgments than in the hour estimates.

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third of the teachers agreed with the statement that "Overall, portfolios are less of a burden on me this year than last year."

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Insert Table 13 about here

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Many observers expected that the demands placed on teachers by the portfolio assessment program would diminish as teachers became more experienced, and this was true to a limited degree. Experience yielded benefits for some teachers: forty to fifty percent of the teachers who participated in the program in 1991-92 said that specific portfolio related activities, such as finding interesting tasks and teaching problem solving, had become easier. However, in most cases a similar proportion of teachers said that the activity was no easier than the year before. (see Table 14) Similarly, we could find little evidence that teachers with three years of portfolio experience found portfolios easier or less time consuming than teachers in their second year. Third year portfolio users were slightly less likely than second year portfolio users to find managing portfolios too time consuming (54% to 47%); but this was the only significant difference.

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Insert Table 14 about here

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One of the most common issues raised by teachers in their open-ended comments (mentioned by 25% of those who commented on "other issues") was the excessive burden placed on fourth and eighth grade students and teachers by the combination of writing and mathematics portfolios. They feel they spend too much time away from their students for training, and that they carry a burden that is not placed on teachers and students at other grade levels. One teacher warned "I support portfolios but fear that you'll lose your allies (even me) by over working them!"

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**Summary**

Overall, the message from Vermont teachers about the portfolio assessment system remains mixed. Most teachers have modified their curricula and teaching practices to emphasize problem solving and mathematical communication skills, but many feel they are doing this at the expense of other areas of the curriculum, especially basic skills and computation. Most teachers express support for mathematics portfolios in a general sense, but there are widespread concerns about using portfolios as an external evaluation tool and, most of all, about the time demands of planning, administering, and scoring portfolio problems. There is little evidence that the burdens on teachers are lessening significantly over time. Furthermore, it is clear that variations in teachers' approaches to implementing mathematics portfolios persist.

Teachers' responses suggest some ways Vermont might improve the portfolio assessment system in the future. First, teachers express strong support for expanding portfolios to all grade levels. For many teachers this is point of efficiency as well as fairness. As long as portfolios are limited to grades 4 and 8, other grades will be slow to adopt practices that support the skills emphasized by the portfolio assessment system. Also, parents, administrators, and other teachers will continue to expect all teachers at grades 4 and 8 to abide by the "traditional curriculum." Secondly, the developmental appropriateness of certain aspects of the grade 4 mathematics portfolios should be re-examined. Many fourth grade teachers are convinced that the writing demands are too great for many of their students. Finally, the State Department of Education should review the balance between local flexibility and standardization of implementation -- while flexibility contributes to the meaningfulness of the portfolios as local instructional tools, it reduces the validity of inferences that can be drawn from the portfolio scores.

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**Table 1**

**CHARACTERISTICS OF SAMPLED TEACHERS, 1991-92 AND 1992-93**

| | 1991-92 | | 1992-93 | |
|---|---|---|---|---|
| | Grade 4 | Grade 8 | Grade 4 | Grade 8 |
| Number | 112 | 32 | 382 | 137 |
| Response Rate | 90% | 67% | 52% | 41% |
| Mean Years Experience | 15.0 | 16.7 | 14.6 | 16.2 |
| Percent Specializing in math | 4.7% | 73.0% | 1.6% | 69.3% |

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**Table 2**

**ASSISTANCE ALLOWED BY TEACHERS ON BEST PIECES**
**(Percentage of Teachers)**

| Source | Grade | Allowed to assist on which best pieces? | | | | Rules Differ for Each Student |
|---|---|---|---|---|---|---|
| | | None | Some | Most | All | |
| The teacher | 4 | 27 | 23 | 14 | 16 | 21 |
| | 8 | 27 | 32 | 9 | 13 | 19 |
| Other students | 4 | 34 | 31 | 11 | 12 | 11 |
| | 8 | 23 | 39 | 11 | 12 | 15 |
| Parents or others outside of school | 4 * | 71 | 13 | 4 | 4 | 8 |
| | 8 | 39 | 28 | 8 | 13 | 11 |

NOTE: * Grade level difference significant at the 5% level ($p<.05$)

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**Table 3**

**WHO SELECTS BEST PIECES**
**(Percentage of Teachers)**

| Who selects best pieces? | Grade 4* | Grade 8 |
|---|---|---|
| Students on their own | 21 | 30 |
| Students with limited teacher input | 55 | 57 |
| Students and teachers have equal role | 18 | 8 |
| Teacher with limited student input | 5 | 3 |
| Teacher | 1 | 1 |

NOTE: * Grade level difference significant at the 5% level ($p<.05$)

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**Table 4**

**TEACHER EMPHASIS ON PORTFOLIO CHARACTERISTICS**
**(Percentage of Teachers)**

| Area of Emphasis | Grade | Amount of Emphasis | | | |
|---|---|---|---|---|---|
| | | None | Minor | Moderate | Heavy |
| Mathematically correct | 4 | 5 | 32 | 54 | 10 |
| | 8 | 8 | 21 | 58 | 13 |
| Neat and polished appearance | 4 | 6 | 40 | 49 | 6 |
| | 8 | 9 | 38 | 49 | 4 |
| Interesting or important to students | 4 * | 1 | 6 | 52 | 41 |
| | 8 | 2 | 14 | 58 | 26 |
| Similar to examples in Resource Guide | 4 | 13 | 29 | 45 | 13 |
| | 8 | 17 | 32 | 42 | 9 |
| Similar to good examples from scoring training | 4 | 6 | 22 | 48 | 24 |
| | 8 | 10 | 25 | 46 | 19 |
| Related to problem solving criteria | 4 | 1 | 6 | 42 | 51 |
| | 8 | 2 | 9 | 48 | 40 |
| Related to mathematical communication criteria | 4 | 2 | 10 | 47 | 41 |
| | 8 | 2 | 17 | 47 | 34 |

NOTE: * Grade level difference significant at the 5% level ($p<.05$)

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**Table 5**

**CHANGE IN TIME SPENT ON PROBLEM SOLVING ACTIVITIES**
**(Percentage of Teachers)**

| Activity | Grade | Somewhat or Much Less | About the Same | Somewhat or Much More |
|---|---|---|---|---|
| Exploring Patterns | 4 | 4 | 42 | 54 |
| | 8 | 5 | 57 | 38 |
| Applying math knowledge to traditional word problems | 4 * | 22 | 34 | 44 |
| | 8 | 17 | 56 | 28 |
| Applying math knowledge to novel problems | 4 * | 2 | 23 | 75 |
| | 8 | 1 | 29 | 70 |
| Solving logic or reasoning problems | 4 * | 1 | 24 | 75 |
| | 8 | 5 | 43 | 51 |
| Applying math to problems in a real world setting | 4 * | 2 | 26 | 71 |
| | 8 | 3 | 43 | 54 |
| Collecting and analyzing data | 4 * | 3 | 38 | 59 |
| | 8 | 10 | 45 | 44 |
| Learning problem solving techniques | 4 * | 1 | 16 | 83 |
| | 8 | 3 | 34 | 63 |
| Examining incorrect solutions | 4 | 5 | 45 | 50 |
| | 8 | 8 | 54 | 38 |

NOTE: * Grade level difference significant at the 5% level ($p<.05$)

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**Table 6**

**CHANGE IN TIME SPENT ON MATHEMATICAL COMMUNICATION**
**(Percentage of Teachers)**

| Activity | Grade | Somewhat or Much Less | About the Same | Somewhat or Much More |
|---|---|---|---|---|
| Writing about mathematics | 4 * | 3 | 8 | 89 |
| | 8 | 7 | 16 | 77 |
| Explaining solutions to problems | 4 * | 3 | 25 | 72 |
| | 8 | 15 | 53 | 32 |
| Discussing mathematics | 4 * | 1 | 29 | 71 |
| | 8 | 5 | 57 | 37 |
| Making or interpreting charts, graphs, diagrams | 4 * | 1 | 29 | 70 |
| | 8 | 7 | 45 | 49 |
| Writing reports about mathematics | 4 | 5 | 44 | 51 |
| | 8 | 9 | 41 | 50 |
| Describing feelings about mathematics | 4 * | 6 | 51 | 43 |
| | 8 | 11 | 60 | 30 |

NOTE: * Grade level difference significant at the 5% level ($p<.05$)

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**Table 7**

**CHANGE IN CLASSROOM ACTIVITIES**
**(Percentage of Teachers)**

| Activity | Grade | Somewhat or Much Less | About the Same | Somewhat or Much More |
|---|---|---|---|---|
| Assign activities whose outcome and/or duration is uncertain | 4 | 3 | 29 | 68 |
| | 8 | 2 | 36 | 63 |
| Vary schedule or length of math activities | 4 * | 1 | 27 | 72 |
| | 8 | 3 | 54 | 42 |
| Involve students in hands-on math activities | 4 | 3 | 46 | 51 |
| | 8 | 3 | 57 | 38 |
| Use supplemental math books | 4 | 14 | 50 | 36 |
| | 8 | 10 | 60 | 30 |
| Use novel materials or supplies in math lessons | 4 | 2 | 46 | 52 |
| | 8 | 3 | 50 | 47 |

NOTE: * Grade level difference significant at the 5% level ($p<.05$)

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**Table 8**

**CHANGE IN CLASSROOM ORGANIZATION**
**(Percentage of Teachers)**

| Activity | Grade | Somewhat or Much Less | About the Same | Somewhat or Much More |
|---|---|---|---|---|
| Discussing together as a whole class | 4 * | 3 | 39 | 58 |
| | 8 | 14 | 58 | 28 |
| Working in groups with students of similar ability | 4 | 19 | 59 | 22 |
| | 8 | 18 | 59 | 23 |
| Working in groups with students of different abilities | 4 | 2 | 52 | 46 |
| | 8 | 2 | 62 | 36 |
| Working in pairs | 4 | 2 | 54 | 44 |
| | 8 | 3 | 60 | 37 |
| Working individually | 4 | 30 | 58 | 12 |
| | 8 | 32 | 64 | 3 |

NOTE: * Grade level difference significant at the 5% level ($p<.05$)

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**Table 9**

**CHANGES IN THE ALLOCATION OF CLASS TIME**
**(Percentage of Teachers)**

| Activity | Grade | Somewhat or Much Less | About the Same | Somewhat or Much More |
|---|---|---|---|---|
| Any math activity | 4 * | 15 | 39 | 46 |
| | 8 | 28 | 52 | 20 |
| Computation | 4 * | 65 | 30 | 5 |
| | 8 | 54 | 43 | 3 |
| Other traditional math topics | 4 | 63 | 32 | 5 |
| | 8 | 56 | 42 | 3 |
| Any writing activity | 4 | 6 | 31 | 63 |
| | 8 | 5 | 24 | 71 |
| Subjects other than math and writing | 4 * | 44 | 47 | 9 |
| | 8 | 9 | 71 | 20 |

NOTE: * Grade level difference significant at the 5% level ($p<.05$)

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**Table 10**

**FREQUENCY OF CLASS ENGAGEMENT IN VARIOUS MATHEMATICS ACTIVITIES**
**(Percentage of Teachers)**

| Activity | Grade | Never | 1-3/ per Sem. | 1-3 per Month | Once per Week | 2-3/ per Week | Daily |
|---|---|---|---|---|---|---|---|
| Computation and other traditional math topics | 4 | 0 | 1 | 2 | 9 | 60 | 28 |
| | 8 | 0 | 2 | 6 | 12 | 51 | 29 |
| Writing about mathematics | 4 * | 2 | 9 | 21 | 41 | 24 | 3 |
| | 8 | 5 | 15 | 26 | 40 | 11 | 3 |
| Applying math knowledge to solve novel problems | 4 | 1 | 5 | 18 | 38 | 33 | 5 |
| | 8 | 2 | 9 | 35 | 33 | 17 | 4 |
| Learning problem-solving techniques | 4 * | 0 | 1 | 15 | 44 | 34 | 6 |
| | 8 | 1 | 5 | 27 | 28 | 29 | 11 |
| Explaining solutions to problems | 4 * | 0 | 2 | 11 | 41 | 34 | 11 |
| | 8 | 0 | 2 | 14 | 32 | 28 | 24 |
| Working in groups with students of different abilities | 4 * | 1 | 4 | 12 | 22 | 31 | 30 |
| | 8 | 5 | 8 | 21 | 18 | 24 | 24 |
| Working on activities whose outcome and/or duration is unknown | 4 * | 3 | 9 | 25 | 37 | 20 | 7 |
| | 8 | 4 | 17 | 32 | 31 | 13 | 3 |
| Using novel materials or supplies in math lessons | 4 * | 3 | 11 | 28 | 26 | 25 | 9 |
| | 8 | 3 | 22 | 27 | 29 | 12 | 7 |

NOTE: * Grade level difference significant at the 5% level ($p<.05$)

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**Table 11**

**STUDENT REACTIONS TO MATHEMATICS PORTFOLIOS BY GRADE AND ABILITY LEVEL**
**(Percentage of Teachers)**

| Student Reactions | Grade | Percent of Teachers Reporting Most/Almost All | | |
|---|---|---|---|---|
| | | Low Ability Students | Ave. Ability Students | High Ability Students |
| Enjoy doing portfolio tasks more than regular math assignments | 4 | 10 | 15 | 43 |
| | 8 | 18 | 23 | 38 |
| Like portfolios better this year than last year | 4 | 14 | 21 | 36 |
| | 8 | 17 | 23 | 28 |
| Learn more math because of the portfolios | 4 | 21 | 30 | 49 |
| | 8 | 25 | 28 | 32 |
| Find portfolio tasks easier than traditional assignments | 4 | 4 | 6 | 14 |
| | 8 | 10 | 10 | 17 |
| Portfolio tasks do not reflect math ability because of poor writing skills | 4 | 46 | 5 | 3 |
| | 8 | 31 | 6 | 2 |

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**Table 12**

**DIFFICULTY APPLYING SCORING CRITERIA TO STUDENT PORTFOLIOS**
**(Percent of Teachers)**

| Criteria | Grade | Never or Seldom | Occasion-ally | Often or Very Often |
|---|---|---|---|---|
| PS1 Understanding | 4 | 76 | 20 | 4 |
| | 8 | 73 | 24 | 3 |
| PS2 How? | 4 | 52 | 38 | 10 |
| | 8 | 51 | 43 | 6 |
| PS3 Why? | 4 | 24 | 48 | 28 |
| | 8 | 27 | 47 | 26 |
| PS4 What? | 4 | 30 | 32 | 38 |
| | 8 | 35 | 25 | 40 |
| C1 Language | 4 | 32 | 40 | 28 |
| | 8 | 32 | 38 | 30 |
| C2 Representations | 4 | 44 | 41 | 15 |
| | 8 | 47 | 41 | 12 |
| C3 Presentation | 4 | 43 | 40 | 16 |
| | 8 | 41 | 47 | 12 |

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**Table 13**

**DEMANDS OF THE MATHEMATICS PORTFOLIO PROGRAM ON TEACHERS**
**(Percentage of Teachers)**

| Statement | Grade | Disagree | Neutral | Agree |
|---|---|---|---|---|
| It is easy to prepare portfolio lessons | 4 | 60 | 22 | 18 |
| | 8 | 52 | 30 | 18 |
| I spend too much time managing portfolios | 4 | 21 | 26 | 53 |
| | 8 | 22 | 28 | 49 |
| Overall, portfolios are less of a burden on me this year than last year | 4 | 55 | 16 | 29 |
| | 8 | 52 | 25 | 22 |
| Scoring portfolio work is not too time consuming | 4 | 84 | 7 | 9 |
| | 8 | 83 | 7 | 10 |
| The portfolio assessment makes it more difficult to cover the mathematics curriculum | 4 | 21 | 15 | 65 |
| | 8 | 16 | 20 | 64 |

NOTE: * Grade level difference significant at the 5% level ($p<.05$)

**Table 14**

**CHANGE IN DIFFICULTY OF PORTFOLIO RELATED TEACHER ACTIVITIES**
**(Percentage of Teachers)**

| Activity | Grade | More Difficult | About the Same | Easier |
|---|---|---|---|---|
| Find interesting tasks | 4 | 10 | 41 | 49 |
| | 8 | 17 | 47 | 36 |
| Decide if task is appropriate for portfolio assessment | 4 | 9 | 35 | 56 |
| | 8 | 15 | 32 | 53 |
| Integrate tasks into the math curriculum | 4 | 13 | 44 | 43 |
| | 8 | 21 | 48 | 32 |
| Teaching problem solving | 4 | 10 | 39 | 51 |
| | 8 | 6 | 48 | 46 |
| Teaching mathematical communication | 4 | 16 | 46 | 39 |
| | 8 | 14 | 47 | 40 |
| Motivate students to work on portfolio tasks | 4 | 18 | 52 | 30 |
| | 8 | 26 | 46 | 28 |
| Make students understand qualities of good pieces | 4 | 18 | 41 | 42 |
| | 8 | 19 | 34 | 47 |
| Explain the portfolios to parents | 4 | 9 | 56 | 36 |
| | 8 | 6 | 68 | 26 |

NOTE: * Grade level difference significant at the 5% level ($p<.05$)

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